REMARKS

The various objections to the original disclosure as set forth in Items 3-6 on pages 2 and 3 of the Office Action mailed May 15, 2003, are noted. Applicant is submitting a Substitute Specification which further clarifies the description of the present invention. Moreover, noting comments by the Examiner in Item 6 on page 3 of the Office Action mailed May 15, 2003, it is respectfully submitted that the presently submitted Substitute Specification is being filed under 37 CFR § 1.125(a); in any event, the undersigned makes the statement that the presently submitted Substitute Specification contains no new matter. In addition, a marked-up copy showing the amendments made via the Substitute Specification relative to the original specification (which is the specification at the time the Substitute Specification is being filed) is also enclosed herewith.

The rejections of claim 1 under the first and second paragraphs of 35 USC §112, respectively as failing to comply with the enablement requirement and as being indefinite, are noted. Applicant has cancelled claim 1 without prejudice or disclaimer, and is adding new claims 11-19 to the application. It is respectfully submitted that these new claims are consistent with the original disclosure, and with the presently submitted Substitute Specification, and are supported by an enabling disclosure as well as being sufficiently definite for satisfying requirements of the second paragraph of 35 USC §112.

Thus, claim 11 to be considered on the merits herein recites a system having an electric motor for driving machines and for electrical power generation, the system

including the electric motor having structure for driving the machine, and a power source. The power source is further defined as being for supplying power to the electric motor such that the electric motor generates electrical power, whereby the electric motor can both drive the machine and generate electrical power. It is respectfully submitted that this claim 11 is within the description of the present invention as set forth, for example, in the description on pages 1-5 and 9-12, and Figs. 1B and 2B, of Applicant's original disclosure, and on pages 1-5 of the enclosed Substitute Specification, and especially in specific embodiments as set forth, for example, in Figs. 1B and 2B, and that the present invention as claimed in claim 11 is enabled by the original specification as well as the enclosed Substitute Specification and is definite.

Please also note newly added independent claim 18. Claim 18 defines a system having an electric motor for driving a machine and for electric power generation, the system including the electric motor, a first power source, a driving-motor for supplying mechanical power to the electric motor to use the electric motor as a generator, and a second power supply for supplying mechanical power to the driving-motor. Claim 18 further defines the electric motor as having a structure for driving the machine; and further defines the first power source as supplying electric power to the electric motor such that the electric motor generates electric power, so that the electric motor can both drive the machine and generate electric power. Again noting the above-referred-to portions of Applicant's original disclosure and Substitute Specification, as well as Figs. 4A and 4B and Fig. 5, together with a description in connection therewith on

page 14, line 19, to page 16, line 12, of Applicant's original specification and page 12, line 11, to page 13, line 23, of Applicant's Substitute Specification, it is respectfully submitted that claim 18 is clearly enabled by Applicant's original disclosure as well as by the enclosed Substitute Specification; and is sufficiently definite to satisfy requirements of the second paragraph of 35 USC §112.

In connection with claim 18, note also claim 13, reciting that the system defined in claim 11, having a power source for supplying power to the electric motor, includes another power source for generating a mechanical power. Similarly as discussed in the foregoing paragraph in connection with claim 18, it is respectfully submitted that Applicant's original disclosure, as well as Applicant's Substitute Specification, enables the subject matter of claim 13, and that claim 13 is definite.

Attention is also directed to the remaining newly added claims, claims 12, 14-17 and 19. Claim 12 recites that the system further includes the machine, adapted to be driven by the electric motor. Claim 19, dependent on claim 18, further defines the electric motor as an alternating current electric motor, recites that the second power source is at least one selected from the group consisting of various sources of power, including sources of wind and hydraulic power and a source of manually-generated power, and recites that the machine is selected from the group consisting of machine tools and compressors. It is respectfully submitted that claims 12 and 19, respectively defining a further component of the system, and further defining the components, are further enabled in view of the specific description in Applicant's original disclosure at pages 9-12, and are further definite in defining the present invention, clearly satisfying requirements of the first and second paragraphs of 35 USC §112.

Attention is also directed to claims 14-17. These claims further define the system of claim 11, and it is respectfully submitted that the further aspects of the present invention as defined in claims 14-17, in view of the additional recitations set forth therein, more clearly define the present invention so as to be even more definite under the requirements of 35 USC §112, second paragraph; and, based on specific recitations therein, are clearly enabled by the original disclosure of the above-identified application. See, e.g., pages 9-16 of Applicant's original disclosure.

The contention by the Examiner as set forth in Item 5 bridging pages 2 and 3 of the Office Action mailed May 15, 2003, is noted. In view of the presently submitted Substitute Specification, as well as the present claim amendments, it is respectfully submitted that the present invention is sufficiently defined so as to be capable of a reasonable search. A full and complete examination of the above-identified application, including a prior art search, is respectfully requested.

In view of all of the foregoing, entry of the present amendments, and reconsideration and allowance of all claims in the application, are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 840.40130X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

William I. Solomon
Registration No. 28,565

1300 North 17th Street
Suite 1800
Arlington, VA 22209
Tel: (703) 312-6600
Fax : (703) 312-6666
WIS:sjg

Title of the Invention: ELECTRIC MOTOR AND GENERATOR

Background of the Invention:

<Technical Field>

electric-driven and electrical power generation system having an electric power generation function

The present invention relates to an electric motor and a generator or an electric drive and power generation system in which a power generation is carried out in a power source such as an electric motor, an internal combustion engine, a wind power, a hydraulic power and a human power using an apparatus and machine.

<Prior Art>

motor drives machines (apparatus)

In general generally, an ordinary electric power such as a rotating machine, a pump and a blower etc., are driven with a single function. For example, the pump is used merely in a transportation of fluid, the blower is used merely to send the air. The electric motor used as the electric power is not utilized in real as a power generation.

and has this — of driving the machine — to drives the pump, blower, etc., — for

Summary of the Invention:

An object of the present invention is to provide an electric motor and a generator or an electric drive and power generation system, wherein by applying a power single function electric motor, the electric motor, an internal combustion engine and a wind power or a hydraulic power from outside portion is utilized, thereby power generation function can be obtained.

driving machine and performing in — an electrical — another — or — to provide power to an electric motor which can both drives a machine and generate electrical power; — an electrical

Another object of the present invention is to provide an

driving machines and performing in an electrical

electric motor and a generator or an electric drive and a power generation system, wherein in a case in which an electric motor is utilized as a power generation single function, a raise-up to a power generation function can be carried out smoothly, and further, in a case of an electric motor and generator complex, The system functions as an economical function an economic system suited for control of an operation control such as a mutual change-over between a single or plural electric motors, driving machines and generators an electrical power generator can be obtained.

A further object of the present invention is to provide an electric motor driving machines and a generator or an electric drive and performing in an electrical power generation system, wherein in a case of a system for applying a driving fluid machinery, an exchange-over of a change-over between an electric drive and a electrical power generation can be carried out only by altering a mechanical structure such as a blade and a fluid transportation mechanism, without an alteration alternation of an electric control line system.

A further object of the present invention is to provide an electric motor driving machines and a generator or an electric drive and a performing in an electrical power generation system, wherein in a case of a system for applying a driving fluid machinery, an exchange-over of a change-over between an electric drive and a electrical power generation can be realized using only by an electric control, without an alteration alternation of a mechanical structure system.

According to the present invention, a system has in an electric motor, and a generator which is constituted using and uses the electric motor as a power source for driving machines and is used to generate electrical power and connected in an electric power line, an electric drive generator is provided integrally or is provided in

separately, thereby a power generation function is obtained.

According to the present invention, in a system having an electric motor (which performs as an electrical power) and a generator, in a case of performing a power generation function, the generator is activated and is risen up has its speed increased near to a synchronous speed and the generator is carried carries out a switch-on operation; in a case of an electric power generation function, the electric motor is instituted made once in a non-load condition and is activated and is risen up (has its speed increased) near once to a synchronous speed from a stop condition and the generator is carried carries out a switch-on operation; and thereby an induction motor excited on an electric power system line or an alternating current is constituted.

According to the present invention, in a fluid machinery having a blade or a water turbine and a rotating machine, in a case of a propelling machine, a twist angle is reversed made reversal, and in a case of a centrifugal machine, an intake port of the fluid is changed over from an air inhale a fluid intake side to an air a fluid exhaust side; thereby without an alteration alternation of a control circuit, a fluid transportation function is changed over to an electrical power generation system.

According to the present invention, in an electric motor and electrical power generator which is constituted using the electric motor as a power source system and is used in an electric power line, (to drive machines) in every case of a power generation function and a complex function of the electric motor as a power source for driving machines and the generator, when a stop stopped motor or a power drawing function is changed over to electrical power generation system, data necessary to control a load condition, an outside portion power condition, a power condition of an outside generator etc. are

detected by a sensor; and in accordance with the detected data the stopped motor ~~stop~~ or the ~~power~~ driving function is changed over to the power generation system, thereby a whole system is operation-controlled.

According to the present invention, in a wind power generation system having an electric motor and a generator for ~~sending~~ blowing air using a blade and for carrying out a wind power generation by taking air ~~into~~ from all directions ~~direction~~, a wind direction guide is installed; and an induction motor is constituted as a main electric machine.

According to the present invention, in a wind power generation system having an electric motor and a generator for ~~sending~~ blowing air using a blade and for carrying out a wind power generation, ~~and having an electric motor and a generator,~~ an inclined magnetic field is formed in a flow passage using one selected from a single permanent magnet, a single electromagnet, plural permanent magnets and plural electromagnets ~~electromagnet~~; and air is moved always according to oxygen in the air and the inclined magnetic field.

According to the present invention, in a fluid power generation system having a fluid machine constituted by a blade, a water turbine and a rotating machine, and having an electric motor and a generator, in a case of a single power generation function, the system is activated as the electric motor and the electric motor ~~is risen up~~ has its speed increased near to a synchronous speed; and in a case of a complex function of the electric motor and the electrical power generator, a rotation magnetic field is varied electrically,

and the system ~~is activated as~~ has the electric motor activated and the electric motor ~~is risen up~~ has its speed increased near to a synchronous speed.

According to the present invention, in a rotating machine having a stator and a rotor, a single conductive member or plural conductive members are provided with a sandwich shape in a laminated iron core; and on an outer peripheral portion of the conductive member, a groove is provided to block ~~not~~ flow of current ~~shortly~~ directly between rotor bars.

According to the present invention, in a rotating machine having a stator and a rotor, a single disc member or plural disc ~~member~~ members are provided in a laminated iron core of the rotor; and the laminated iron core of the rotor is projected from an axial direction length of an iron core of the stator.

According to the present invention, in a rotating machine, an extension portion of a rotor bar is formed on an outer peripheral portion of an end ring; thereby a magnetic field ~~filed~~ of an overhang portion of the laminated iron core of the rotor is formed validly.

Brief Description of Drawing:

~~Fig. 1 is an~~ Figs. 1A and 1B are explanatory ~~view~~ views showing one embodiment of ~~an electric motor and a generator or~~ an electric drive and electrical power generation system according to the present invention (Fig. 1B) and ~~an explanatory view~~ showing ~~of~~ an electric drive system in which an electric drive is mainly according to the prior art (Fig. 1A);

~~Fig. 2 is an~~ Figs. 2A and 2B are explanatory ~~view~~ views showing one embodiment of an induction motor for simplifying the ~~electric motor and the~~

generator system or the electric drive and power generation system according to the present invention (Fig. 2B) and an explanatory view showing the electric drive system using an induction motor in which the electric drive is mainly according to the prior art (Fig. 2A);

Figs. 3A1, 3B1 and 3C1 are Fig. 3 is an explanatory view views showing an application example to a generator of a fluid machinery represented by a blower or a pump;

Figs. 4A and 4B are Fig. 4 is an explanatory view views showing an electric motor and a generator using plural fluid machinery according to the present invention and using sensor groups for detecting such parameters as a flow velocity and temperature by which a respective operation condition is grasped and controlled;

Fig. 5 is an explanatory view showing an electric motor and a generator according to the present invention in which the electric motor and the generator are installed at a place where an electric power line is not provided;

Figs. 6A and 6B are Fig. 6 is an explanatory view views showing an air acceleration element of a magnet according to the present invention;

Figs. 7A and 7B are Fig. 7 is an explanatory view views showing a wind power generator for taking air from a whole periphery and for carrying out electrical power generation according to the present invention;

Figs. 8A and 8B are Fig. 8 is an explanatory view views showing a rotor structure of a rotating machine according to the present invention (Fig. 8A) and is an explanatory view showing a rotor structure of a rotating machine according to the prior art (Fig. 8B);

Figs. 9A1 - 9A3 and 9B1 - 9B3 are Fig. 9 is an explanatory view views showing an inner conductive

member and an outer conductive member of a rotor structure of a rotating machine according to the present invention;

Figs. 10A1-10A6 are
views
[Fig. 10 is an] explanatory [view] showing a combination of a winding type conductive member and a cage type conductive member according to the present invention;

Figs. 11A-11C are
views
[Fig. 11 is an] explanatory [view] showing a divided iron core structure for increasing centrifugal force according to the present invention;

Figs. 12A-12C are graphs showing change in characteristics of various kind of induction generators
[Fig. 12 is various characteristic view showing an induction generator according to the present invention];

Figs. 13A1, 13A2, 13B1 and 13B2 are
views
[Fig. 13 is an] explanatory [view] showing an effect in a case where a rotor iron core is projected or over-hung from a stator iron core according to the present invention;

Figs. 14A1, 14A2, 14B1 and 14B2 are
views
[Fig. 14 is an] explanatory [view] showing an effect in a case where a stator iron core is projected or over-hung from a rotor iron core according to the present invention;

Figs. 15A1-15A4 are
views
[Fig. 15 is an] explanatory [view] showing an improvement example of a rotating machine having a slot-less iron core according to the present invention;

Figs. 16A and 16B are
views
[Fig. 16 is a] structural [view] showing a generator in which a rotor is formed by extending a magnet or an electromagnet in an axial direction according to the present invention (Fig. 16A) and is a structural view showing a generator according to the prior art (Fig. 16B);

Figs. 17A-17F are
views
[Fig. 17 is a] cross-sectional explanatory [view] showing a magnet type rotor of an outer-rotor type generator according to the present invention and six embodiments [are shown in an

explanatory view of a magnetic flux of an air gap;

Figs. 18A-18F are views

Fig. 18 is a cross-sectional explanatory view showing a magnet type rotor of an inner-rotor type generator according to the present invention and six embodiments are shown in an explanatory view of a magnetic flux of an air gap;

Fig. 19 is a view showing a divided iron core structure of a magnet type rotor of an outer-rotor generator according to the present invention;

Figs. 20A-20E are views

Fig. 20 is a view showing a divided iron core structure of a cage type rotor of an outer-rotor generator according to the present invention;

Figs. 21A and 21B are views

Fig. 21 is a view showing a divided iron core structure of a magnet type rotor of an outer-rotor generator according to the present invention, and the magnet is arranged on a solid face of the divided iron core;

Figs. 22A-22H are views

Fig. 22 is an explanatory view showing a two-pole magnetic pole electomagnet electromagnet having a donut structure enable able to combine with another magnet according to the present invention;

Figs. 23A-23H are views

Fig. 23 is an explanatory view showing a six-pole magnetic pole electomagnet electromagnet having a donut structure enable able to combine with another magnet according to the present invention;

Figs. 24A and 24B are views

Fig. 24 is an explanatory view showing a combination example of four kind kinds of electromagnets and two kind kinds of magnets of a rotor of a six-pole rotating machine to understand the combination example of the magnet and the electromagnet according to the present invention;

Figs. 25A-25J are views

Fig. 25 is an explanatory view showing a combination

electromagnet

example of a magnet and an electomagnet in an inner-rotor type according to the present invention;

Figs. 26A-26J are views

Fig. 26 is an explanatory view showing a combination example of a magnet and an electomagnet in an outer-rotor type according to the present invention;

electromagnet

Figs. 27A-27D are views

Fig. 27 is a view showing a stator of a three-phase two-pole motor using three inner -outer periphery magnetic pole type electromagnets according to the present invention;

Figs. 28A-28D are views

Fig. 28 is a view showing a stator of a three-phase six-pole motor using three inner -outer periphery magnetic pole type electromagnets according to the present invention;

Figs. 29A-29J are views

Fig. 29 is an explanatory view showing a structure of a two-pole electromagnet iron core according to the present invention; and

Figs. 30A-30F are views

Fig. 30 is an explanatory view showing an iron core structure for lessening an eddy current loss of an alternating current electromagnet according to the present invention.

Description of the Invention:

electrical

Hereinafter, one embodiment of an electric motor and a generator or an electric drive and power generation system according to the present invention will be explained referring to the drawings.

Figs. 1A and 1B are comparison views respectively

Fig. 1 is a comparison explanatory view of an electric drive system in which an the electric drive is mainly according to the prior art and an electric motor and a generator or an electric drive and power generation system according to the present invention.

of electrical

Fig. 1A is an explanatory view showing

the system according to the prior art, and electric motors 10 and 10a are connected to an electric power line 1 are applied to and the system is used to a supply power for a machine tool 20 and a compressor 21. As stated in above, in the job sites such as works and a consumer, the electric motor is used generally as a mere power supplier. The electric motors 10 and 10a, the machine tool 20 and the compressor 21 are controlled by control board 30 and 30a.

On the other hand, the electric motor and the generator or with the electric drive and electrical power generation system according to the present invention, as shown in Fig. 1B, an electric motor having being utilized merely as a to supply power in the prior art is utilized as a generator by adding a prime mover in an outside portion or by replacing with using an integral electric drive generator, and according to the present invention an electric drive and power generation system can be obtained. In a case where the electricity generated by the power generation system of the electric motor according to the prior art is insufficient short, a new generator monopoly use internal combustion engine 40a, generators 10b, 10c connected to an electric motor 11a can be added.

To an outside portion of the electric motors 10 and 10a connected to the electric power line 1 the internal combustion engine 40 as the prime mover and the electric motor 11 are added, and the electric motors 10 and 10b having been used as the electric motor in the prior system are used as the electrical power generators 10′ and 10a′. These apparatuses are controlled by control board 30b

and 30c. The newly added generators 10b and 10c are controlled by control boards 30d and 30e. A condenser 60 is provided to accumulate surplus electric power to perform the electric power supplement and the take-in and the take-out of the electric power can be carried out between this condenser 60 and the electric power line 1 through an inverter 50.

Figs. 2A and 2B are ~~Fig. 2 is an~~ explanatory views ~~view~~ showing an example of the system of the electric motor which is constituted with an induction motor to constitute simply the system explained with Figs. 1A and 1B ~~Fig. 1~~. Fig. 2A is an explanatory view of ~~a~~ system according to the prior art and induction motors 12, 12a and 12b connected to an electric power line 1a have power ~~are~~ applied to. ~~By representing~~ Represented as a fluid machinery driven by ~~to~~ the induction motor 12 is a blower having blades 70 ~~is~~ installed and ~~is~~ operated as the blower, and the induction motors 12a and 12b are used as a power for a pump hydraulic turbine 22 and a compressor 23. As stated ~~in~~ above, in the job sites such as works and a consumer, the electric motor is used generally ~~as a~~ merely to supply power. The induction motors 12, 12a and 12b, the pump hydraulic turbine 22 and the compressor 23 are controlled by control boards 31, 31a and 31b.

On the other hand, in the electric drive and electrical power generation system according to the present invention shown in Fig. 2B, in the prior art the system is operated as the blower in which the blades 70 are installed to the induction motor 12. However, according to the present invention, ~~only~~ by altering electric circuits, the system can be utilized ~~it utilizes~~ as a generator 12′ or to the generator 12′ is formed as a power using water etc. from an

outside portion, or by replacing it with an integral type electric and power generator 13, accordingly the system is utilized as the generator. According to the present invention an electric drive and power generation system can be obtained.

In a case where the electricity generated by the electric motors 12', 12a' and 13 according to the prior art is insufficient ~~short~~, a new generator monopoly internal combustion engine 41, generators 12c, 12d and 12f driven by an electric motor 12e and ~~a~~ human power 28 can be added. The generators 12', 12a' and 13 are controlled by control boards 31c, 31d and 31e. The newly added generators 12c, 12d and 12f ~~10b and 10c~~ are controlled by control board 31f, 31g and 31h. An energy accumulation unit 61 such as a condenser 61 is provided to accumulate surplus electric power to perform the electric power supplement and the take-in and the take-out of the electric power can be carried out between this condenser 61 and the electric power line 1a through an inverter 51.

In a case where the induction motor is utilized as the generator, in the induction motor and ~~a~~ an asynchronous generator a rotor ~~for~~ suited to the control can be formed with a winding type rotor and a deep groove type rotor.

Figs. 3A1 and 3A2, 3B1 and 3B2, and 3C1 and 3C2 are
Fig. 3 ~~is an~~ explanatory ~~view~~ views of an example of a generator applied to a fluid machinery which is represented by a blower and a pump etc. Fig. 3A1 and Fig. 3A2 show~~s~~ cases in which the system is operated as the blower. The blower is connected to an electric power line 1b and is constituted by blades 71 and an electric motor 14. The electric motor 14 is made to ~~be~~

rotate rotated the blades 71 by a control board 32 and the wind is flown out in an arrow direction shown in the figures. Fig. 3A2 is a cross-sectional view which is developed by cross-sectioning a circular periphery in some radial portion from a rotation center of the blade 71. Since the blade is rotated in a black arrow mark rotation direction, the wind is sent out in the arrow direction.

In Fig. 3B1 and Fig. 3B2, a mechanical alteration alternation of the blade 71 etc. of the blower shown in Fig. 3A1 and Fig. 3A2 is not carried out wholly but an electric alteration alternation is carried out. From the electric viewpoint, in a case of a multi-phase rotating machine a phase order is altered and a case of a single-phase rotating machine a polarity characteristic of a main winding is altered and the rotation direction of the blower is changed and then a reverse outside an external wind reversed in direction to that in Figs. 3A1 and 3A2, is received and the electrical power generation is carried out.

In this case, even with small outside wind to carry out the electrical power generation, the rotation number of the electric motor 14a is risen increases near to a synchronous speed, and the power generation is carried out with the large rotation number being suited to the a wind power larger than the synchronous speed. The voltage is one that of the electric power line 1b, and the current being suited to the electricity generated is supplied to the electric power line 1b. A control of this blower is carried out using a control board 32a. Fig. 3B2 shows a cross-section of the blade 71 which is the entire same one shown in Fig. 2A2.

In Fig. 3C1 and Fig. 3C2, an electrical circuit

~~alternation~~ alteration of the blade 71 etc. of the blower shown in Fig. 3A1 and Fig. 3A2 is not carried out wholly but a mechanical ~~alternation~~ alteration is carried out. From the mechanical viewpoint, a blade 71a which has a reversal twist angle of the blade 71 etc. and in a case of a centrifugal blade only a mechanical ~~alternation~~ alteration such as a flow passage is carried out, and then ~~receiving the reversal~~ wind reversed to to the wind sending direction, for the power generation is carried out.

In this case, even with small outside wind to carry out the power generation, the rotation number of the electric motor 14b ~~is risen~~ increases near to a synchronous speed, and the power generation is carried out with the large rotation number being suited to the wind power larger than the synchronous speed. The voltage is ~~one~~ that of the electric power line 1b, and the current being suited to the electricity generated is supplied to the electric power line 1b. A control of this blower is carried out using the control board 32b. Fig. 3C2 shows a cross-section of the blade 71a which has the entire reversal twist angle shown in Fig. 3A2.

Fig. 4A and Fig. 4B show the systems among the electric drive and power generation systems using the plural fluid machinery according to the present invention. The electric drive condition, the power generation condition, the load condition and the environment condition are picked up or grasped according to the various ~~kind~~ kinds of sensors 91, 91a and 91b, then the operation condition is grasped, and further using central controllers 82 and 83 a whole system control is carried out, as a result an effective operation can be carried out.

Fig. 4A [4Aa] shows an example of the system in which the electric drive ~~generation~~ is changed over at the same time in the whole system, and Fig. 4B [4Ab] shows an example of the system whereof [among] the total number of the blowers in the electric drive and pow- generation system the respective operation number of the power generation or the electric drive is determined, and at the same time the complex operation of the power generation and the electric drive is carried out.

In Fig. 4A and Fig. 4B, reference numerals 17, 17a and 17b [indicated] indicate electric drive generators, reference numerals 72, 72a and 72b indicate blades, and reference numerals 34, 34a, 34b, 34c, 34d [35d], and 34e indicate control boards for controlling the respective blowers. A reference numeral 63 indicates an energy accumulation unit such a condenser and a reference numeral 53 [indicate] indicates an energy conversion unit such as an inverter.

Fig. 5 is an explanatory view showing an example of a case where the electric drive and power generation system according to the present invention is constituted in a place having no electric power line and a transportation facility such an automobile and the voltage and the frequency of the electric power line 1d can be selected as a most suited one for the system. As the power supply for supplying the electric power to the electric power line 1d there are the energy accumulation unit 64 and the inverter 54, and the alternating synchronous generator 18d is driven by a prime mover 43b such as an internal combustion engine and the power generation is carried out. The electric drive power generation unit connected to the electric power line

1d has the above stated contents and the detailed ~~detail~~ explanation thereof will be omitted. Reference numerals 18, 18a indicate electric drive generators, reference numerals 18b, 18c and 18d indicate generators, and a reference numeral 19a indicates a drive use electric motor of the generator 18c. A reference numeral 26 indicates a pump hydraulic turbine, and reference numerals 43a and 43b indicate prime movers such as the drive use internal combustion engine. A reference numeral 100 indicates a condenser used for a power factor improvement of the system load and a power generation wave form adjustment, and a reference numeral 101 indicates a general load means for supplying the electric power using the electric power line 1d.

Figs. 6A and 6B are ~~Fig. 6 is an~~ explanatory ~~view~~ views showing an example of a case where, to the blower, an element for moving the air using a magnet 104 is mounted, and in Fig. 6A one element is mounted and in Fig. 6B plural elements are mounted. A reference numeral H indicates an inclined hole in which the magnetic field is strengthened ~~strengthen~~ in a wind flow direction, and since the oxygen in the air is a paramagnetic substance the air is moved without the energy and the performance of the blower can be increased ~~heighten~~. For example, under the magnetic field of 1 Stera, the wind velocity of 0.6 m/s can be obtained. Fig. 6B is an example in which in a magnet 105 plural elements are provided and blowing ~~the move~~ of the air can be further increased ~~heighten~~ without the energy. A reference numeral 15 indicates an electric motor, a reference numeral 74 indicates a blade and reference numerals 102 and 103 indicate frames. In a case in which the magnet is replaced with an electromagnet,

the similar effects can be obtained.

Figs. 7A and 7B show [Fig. 7 shows] a wind power generator which carries [carried] out the power generation by receiving the wind from a whole periphery and in this generator a wind direction guide 107 is arranged in a surrounding portion of a centrifugal blade 75 and in any wind direction the wind can work validly to the blade. Fig. 7A shows a whole cross-sectional view and Fig. 7B is a cross-sectional view showing a relationship between a blade 75 and a wind direction guide 107. A reference numeral 15a indicates a generator.

Figs. 8A and 8B show [Fig. 8 is] an inner-rotor type induction motor. Fig. 8A is a cross-sectional structure showing the induction motor having a rotor 113 which is constituted by combination of a rotor 113 formed by a rotor bar 111 with an electromagnet 120, and Fig. 8B is a cross-sectional structure showing the induction motor having a conventional rotary bar rotor 113'. When the electric power is applied to coils wound around in stators 112 and 112' by cords 119 and 119', [the] a rotation magnetic field occurs and the electromagnetic force generates between the current generated in the rotors 113 and 113', and then it works as the electric motor.

Further, a rotor 113 is driven from an outside according to the power source and to the coil 115 wound around in the stators 112 and 112', the voltage occurs in response to the rotation number and to electric power take-in cords 119 and 119' the load such as the resistance is connected and then current flows [into] and the electric power is generated [supplied]. The generation

voltage of the coil is proportional to the magnetic flux density of the air gap between the stator and the rotor and also is proportional to the rotation number. According to the present invention, by the structure of the rotor 113 and by the combination of the electromagnet 120, a suitable electrical power generation system can be obtained.

Next, as to the rotor according to the present invention, hereinafter the iron core structure, the conductive plate, the rotor bar and the winding constitution etc. will be explained referring to the figures. Figs. 9A1-9A3 and 9B1-9B3 are ~~Fig. 9 is an~~ explanatory ~~view~~ views showing the rotor according to the present invention; and ~~in~~ Fig. 9A1, Fig. 9A2 and Fig. 9A3 show respectively the induction motor in which a notch portion C is provided on an outer peripheral portion and the current flowing through ~~having flown~~ the rotor bar 111a ~~11a~~ flows through the conductive plate 126 in which the outer periphery is cut off and the inner peripheral portion of the disc conductive plate 127' in which the electric resistance of the outer peripheral portion is increased, and then the activation and the output characteristic are improved.

With this construction, the magnetic resistance is increased by surrounding the ferro-magnetic substance arranged in ~~the~~ both wall sides of the conductive plate 126 and a disc conductive plate 126' and the iron core 134, and ~~the~~ in response to the height of the frequency the current is limited and then an activation characteristic and the output characteristic to the rotation number can be improved. A rotor bar 125 arranged in the iron core inner peripheral portion has the similar

operation to the that of the conductive plate 126 and the disc conductive plate 126', and by arranging the ferro-magnetic substance 141 in the vicinity the effects can be strengthened strengthen. The width in the axial direction of the rotor iron core 124a is formed larger than the axial direction width of the stator iron core 112a, so that the magnetic flux density can be reduced. To make the electric resistance in the rotor bar small, the electric circuit between the conductive plate 126 provided at the central portion and the disc conductive plate 126' and an end ring 123a is formed short as soon as possible, and then the output improvement and the efficiency efficiency-up can be improved.

A reference numeral 115 indicates a stator winding, and a reference numeral 118 indicates a shaft. A reference numeral 127a indicates a penetration hole which is provided on an outer peripheral portion of the conductive plate 126, and the disc conductive plate 126' and a rotor bar 111a are is penetrated. A reference numeral 128 indicates a penetration hole which is provided on an inner peripheral portion of the conductive plate 126 and the disc conductive plate 126' and a rotary bar 115 is penetrated. A reference numeral 129a indicates a penetration hole of the shaft 118a.

Further, as shown in Fig. 9B1, Fig. 9B2 and Fig. 9B3, to the both sides of the rotor according to the present invention, which is constituted by a rotor bar 111b, an end ring 123b and a rotor iron core 124b 124, an electromagnetic coil 120b is arranged,; using the direct current for flowing the this electromagnetic coil 120b, a the direct current magnetic field is formed, and, using

the alternating current with the single phase or the multi-phase, the rotation magnetic field is formed, and the activation characteristic tic and the output characteristic of the rotating machine can be improved. A reference numeral 112b indicates a stator iron core, a reference numeral 115b indicates a rotor iron core, and a reference numeral 118b indicates a shaft. A reference numeral 123b indicates an end ring, a reference numeral 127b indicates a penetration hole of the rotor bar, and a reference numeral 129b indicates a penetration hole of the shaft 118b.

Figs. 10A1-10A6 show
Fig. 10 an example for realizing the required characteristics of the rotating machine by combining the cage type rotor shown in Fig. 9B1 and the coil conductive member according to the present invention. Fig. 10A1 is similar to that of Fig. 9B1 and the explanation thereof will be omitted.

Fig. 10A2 shows a rotor in which a rotor bar 125a is arranged in an inner periphery of a rotor iron core 124c and in an outer peripheral portion a coil 130 is arranged. The activation characteristic and the generator characteristics are coped with the coil 130, and the coil 130 is used mainly for varying widely the characteristic of the near synchronous speed shown in a graph of Fig. 12A. A reference numeral 112c indicates a stator iron core, a reference numeral 115c indicates a rotor iron core, and a reference numeral 118c indicates a shaft.

Fig. 10A3 shows a rotor in which a rotor bar 125a is arranged in an inner periphery of a rotor iron core 124c, and

at an outer peripheral portion a coil 130a is arranged, and then the activation characteristic and the generator characteristic can be coped with the rotor bar 125a, and the coil 130a varies mainly widely the characteristic in the near synchronous speed as shown in a graph of Fig. 12C. A reference numeral 112d indicates a stator iron core, a reference numeral 115d indicates a rotor iron core, and a reference numeral 118d indicates a shaft.

Fig. 10A4 shows an example, with a similar constitution shown in Fig. 10A3, in which a thickness of the rotor iron core 124d is formed thicker than a thickness of the stator iron core 112e. The characteristic in the near synchronous speed is varied widely with the coil 130b as shown in a graph of Fig. 12C, and the hangover effect of the iron core is aimed and then the whole output characteristic and the efficiency improvement can be attained. A reference numeral 112e indicates a stator iron core, a reference numeral 115e indicates a stator winding, a reference numeral 118e indicates a shaft and a reference numeral 125b indicates a rotor bar.

Fig. 10A5 and Fig. 10A6 show examples in which rotor bars 125c and 125d arranged in the vicinity of the inner periphery of the rotor iron cores 124e and 124f and single or plural conductive plates 126b and 126c are put side by side. Reference numerals 112f and 112g indicate stator iron cores, reference numerals 115f and 115g indicate stator windings, reference numerals 118f and 118g indicate shafts, and reference numerals 130c and 130d indicate coils.

Further, as seen in ~~from~~ Fig. 10A2 to Fig. 10A6, it is possible to replace the rotor bar with the coil. To the coil is applied a ~~the~~ voltage having a phase different 90 degrees with the rotor secondary induction voltage, ~~is applied~~ and the power fact of the induction generator can be varied voluntary, and as a result in response to the load connected to the power line the power factor balance can be taken validly. Further the direct current flows ~~is flown~~ to the coil and the direct current electromagnet is formed, and ~~than~~ it can use ~~to the~~ a synchronous motor, ~~and the~~ a brushless motor, ~~the~~ a linear motor, and ~~the~~ a pancake type motor.

Figs. 11A-11C are ~~Fig. 11 is an~~ explanatory views ~~view~~ showing an example of a rotor structure for preventing the deformation and the fly out according to the centrifugal force acted on the iron core accompanying with the rotation in a case the rotor iron core is divided to insert the magnets. Fig. 11A shows a cross-sectional view of the stator and the rotor of the rotating machine to which the present invention is applied. A reference numeral 112h indicates a stator iron core, and a reference numeral 115h indicates a stator winding. In the rotor, the rotor iron core 124h is separated in a central portion by a conductive plate 126d and a reinforcement plate, and to the both side faces of the rotor iron core 124h, an end ring 123c is arranged and to an outer peripheral portion a rotor bar 111d is arranged.

In Fig. 11B, to the end ring 123c a ring shape projection 131 is provided and to the iron core 124h a ring shape groove 135 which engages ~~engaged~~ with the projection 131 is provided. A

reference numeral 127c indicates a hole which is provided on the divided iron core 124h in which the rotor bar 111d penetrates, and a reference numeral 134 indicates a spacer for supporting and fixing the divided iron core 124h. Fig. 11C shows an example in which a conductive plate 126d constituted to separate the divided iron core 124h is utilized as a reinforcement plate for preventing the deformation and the fly out by the centrifugal force. To the both faces of the conductive plate 126d the projection pins 136 are provided, to the divided iron core 124h plural holes 133 for engaging the pins 136 are provided. A reference numeral 127s is a hole in which the rotor bar 111d provided on the conductive plate 126d penetrates.

Figs. 12A~12C

Fig. 12 are graphs showing the variation (the change) of the characteristics of the various kinds of induction generators. Fig. 12A shows the characteristic changes of the generator due to the resistance change of the conductive substance of the rotor. The resistance becomes large in proportion to from a graph c1 to a graph c5. Fig. 12B is a graph showing the characteristic in which the frequency of the exciting use power source is varied. The power source frequency becomes large in proportion to from a graph c6 to a graph c8.

Fig. 12C is a graph showing the change in the characteristics in which the voltage of the exciting use power source is varied and the characteristic in the near synchronous speed is varied widely. A graph Line c10 is one of the conditions condition before the characteristic change, and a graph line c9 is one in which the voltage having the reversal a reverse phase to that of the current for flowing through

the rotor winding is added, under the condition where the rotation number before the alteration alternation is lowered the characteristic can be moved in parallel. Line A graph c11 is one in which the voltage having the same phase as that of to the current for flowing the rotor winding is added, under the condition where the rotation number is raised before the alteration alternation is raised the characteristic can be moved in parallel.

Figs. 13A1, A2, B1 and B2 are examples Fig. 13 is an example in which the widths of the rotor iron cores 124i, 124j and 124m are extended beyond over than the axial direction widths of the stator iron cores 112i and 112j, and the hangover portion rotor bar 111e and the winding 130e can be used effectively, and then the characteristics such as the performance improvement and the efficiency improvement can be attained. Namely, the diameters of the end ring 123d and a coil end E of the rotor winding 130e are formed as small as possible, for example less than 1/3 of the outer diameter of the rotor, and they are arranged in the vicinity of the shafts 118i and 118j.

As shown in Fig. 13A2, the magnetic field formed by the current for flowing through the rotor bar increases the magnetic field in the air gap portion. To ensure the magnetic field formation, the iron cores 124j, 124k and 124n 124 formed by the sintering and laminated layer are provided. The magnetic flux formed by the current I passes through to the outside portion once and passes through the iron cores 124k and 124n and returns to the air gap from the adjacent pole iron core. Reference numerals 115i, 115 j indicates 115j indicate stator windings, and a reference numeral 126e is a

conductive plate which works the same role of the deep groove rotor bar and the end ring 123d.

Figs. 14A1, 14A2, 14B1 and 14B2 are examples

Fig. 14 is an example in which an axial direction length of the rotor iron cores 124o and 124r is formed longer that the length of the stator iron cores 112k and 112m and the characteristic improvement and the efficiency improvement can be obtained. Fig. 14A1 and Fig. 14A2 are examples in which the stator iron core 112k is extended to the hangover rotor bar 111f and the characteristic improvement is obtained by an additional action between the current I for flowing the hangover rotor bar 111f and the stator winding 115k. Reference numerals 124p and 124q are iron cores which are made (of sintered) by the sintering material and have ~~the~~ small eddy loss. A reference numeral 118k indicates a shaft, and a reference numeral 126f indicates a conductive plate.

Figs 15A1-15A4 show

Fig. 15 is a rotary machine in which in the windings of the stator and the rotor slot-less cylindrical shape iron cores 112n and 124u are fixed to the coils 115n and 130f using an adhesive agent, etc., and then the cogging torque can be made small and the activation torque can be made small and the efficiency can be improved. To not deform or not to peel off the fixed coils 115n and 130f during the rotation time, ~~using~~ a fastening projection 151 provided on cylindrical shape holding members 150 and 150a (and) the hole provided on the cylindrical iron cores 112n and 124u are utilized. To the adhesive agent 160 magnetic substance powders (160a) ~~160~~ are immersed.

Fig. 15A1 is an explanatory view showing an example in

which to the stator core a slit-less iron core is applied, and Fig. 15A2 is an explanatory view showing an example in which to the rotor core a slit-less iron core is applied. A reference numeral 111g indicates a rotor bar of a cage type rotor and a reference numeral ~~123s~~ 123f indicates an end ring of the cage type rotor. Reference numerals 118n and 118o indicate shafts, and a reference numeral 112o indicate a stator iron core and a reference numeral 115o indicates a stator iron core. Fig. 15A3 is a view in which the winding is developed in a circumferential direction. Fig. 15A4 is a cross-sectional view in which Fig. 15A3 is seen from a side face, and the relationship between the cylindrical iron core 112, the coil 115 and the holding member 150 and the fastening projection 151 is shown.

~~Fig. 16 shows~~ Figs. 16A and 16B show an outer-rotor type generator. Fig. 16A is a cross-sectional view showing the generator having a rotor 202 which is constituted by magnets 214 or electromagnets 242 and 243 and a combination thereof according to the present invention, and Fig. 16B is a cross-sectional view showing a generator having a conventional cylindrical type magnet rotor 202'.

Next, the magnetic flux improvement counter-measurement in the air gap according to the magnets will be explained referring to ~~Fig. 17~~ Figs. 17A-17F and ~~Fig. 18~~ Figs. 18A-18F. ~~Fig. 17 is an example~~ Figs. 17A-17F are example showing the outer-rotor type generator and ~~Fig. 18 is an example~~ Figs. 18A-18F are examples showing the inner-rotor type generator. In a cross-sectional figure shown in Fig. 17A, the generator is constituted by a power transmitting outer frame 210 in which a rotor material is made

of a non-magnetic substance, six divided iron cores 213 and six magnets 214. In this case a space sandwiched by the stator, a portion and b portion of a side outer frame, the outer frame 210 and the iron core 213 is constituted by a non-magnetic substance. Since the twice times of the radial direction length of the magnet 214 is made larger than the circumferential direction length of one pole part of the air gap portion, the magnetic flux in the air gap portion can be made larger than the magnetic flux of the magnet 214.

Fig. 17B ~~18B~~ is an example in which the magnets 214a and 214b having the different strength are inserted into a slit. Fig. 17C ~~18C~~ is an example in which a cross-section of the magnet is a trapezoid shape. Fig. 17D ~~18D~~ is an example in which two magnets having the same strength are increased per one pole. Fig. 17E ~~18E~~ is an example in which two kinds of magnets are used, and a main magnet 214 determines the magnetic field in the air gap and a magnet 214′ adjusts minutely the magnetic field. Fig. 17F ~~18F~~ is an example in which to the conventional cylindrical magnet the magnet according to the present invention is combined.

Fig. 18A – Fig. 18F show the inner-rotor type generator and have a reversal structure of the outer-rotor type generator shown in Fig. 17A – Fig. 17F ~~17~~ and since the structure thereof is basically to the same one the explanation thereof will be omitted.

Fig. 19 is a plan view showing an example of the divided iron core part of the rotor of the above stated outer-rotor type generator and facing to the air gap between the stator three slots 231 are provided.

Figs. 20A - 20E are examples

Fig. 20 is an example in which using the structure shown in Fig. 19A to the rotor of the outer-rotor type generator the cage type rotor is formed. The structure of a cage type rotor part is shown in Fig. 20B and Fig. 20C and is made of the conductive member such as aluminum and brass, and by two side sheets 218 and plural bars 219 the rotor is formed integrally using the caulking and die casting. When the magnet according to the present invention is extended to the axial direction, in a case shown in Fig. 20B, the iron core is separated by the side plate 218.

In Fig. 20C, the radial direction length of the side plate 218 is formed as small as possible, and the cross-section thereof is formed the same and is extended in the axial direction. The side plate is arranged in the inner peripheral face of the magnet iron core (in the case of the inner-rotor type generator, to the outer peripheral face thereof), to concentrate the magnetic flux from the magnet which is extended to the both sides and the electromagnet to the stator air gap, and further the side plate is arranged with a stepwise part 232, which is provided to prevent the leakage from the side face of the stator, of the rotor iron core, and thereby the effect on the magnetic path can be lessened.

Fig. 20D is an example in which only the magnet 214 is extended in the axial direction of the rotor, and Fig. 20E is an example in which electromagnets 242 and 243 are added to the both sides of the rotor magnet 214 faced with the stator 212. In this case, a magnetic flux leakage gap 252 of the

electromagnet 242 and a magnetic flux leakage gap 253 of the electromagnet 243 are provided to work validly to the prevention of a short-circuit of the magnetic flux to the stator.

Figs. 21A and 21B are

Fig. 21 is an example of a case where there is a limitation of the space of the magnetic pole arrangement of the electric motor and the generator as shown in Fig. 17F[;] utilizing validly the limited magnetic pole space, a whole face or a part of the solid face of the magnets are arranged organically and to the air gap portion the magnetic flux can be concentrated at the maximum. For example, a magnet 214a'' and a magnet 214d arranged to the axial direction magnetic pole face can be formed in a ring shape and can be formed as an integral structure. Further, by combining a magnet 214c or a magnet 214b'', a cap shape can be formed.

shaped

The magnet 214c is a cylindrical shape magnet which is arranged in the outer peripheral portion of the magnetic pole, and on the periphery thereof an iron core 213a for forming the magnetic path of the magnetic flux is arranged. To an outer side of the magnet 214d an iron core 213b is arranged, and the magnet 214d is worked validly. All magnets are settled and arranged to concentrate the magnetic flux to the air gap portion and have the polarity of the respective magnet of N and S shown in the figures.

Figs. 22A-22H   Figs. 23A-23H

Fig. 22 and Fig. 23 are explanatory views showing a donut shape electromagnet structures which are able enable to be combined combine with another magnet and electromagnet. Figs. 22A-22H show examples Fig. 22 shows an example in which the magnet poles are two poles and Fig. 23 shows an example in which the magnet poles are six poles. Next, the

Figs. 23A-23H show examples

[detail] detailed explanation of the electromagnets will be explained referring to [Fig. 22] Figs. 22A-22H. In Fig. 22A and Fig. 22B, to an outer periphery two magnetic poles of N and S are formed, and when they are used as the rotor it can apply to the inner-rotor type generator.

Further, in the case of the combination with [the another] other magnets and electromagnets, by adjusting the other part magnetic poles, they are carried out on the outer peripheral face. The adjustment of the magnetic pole is carried out by varying the magnetic polarity of the direct current power source from terminals of a and b of a coil 260a. A reference numeral 250 indicates a gap for preventing the short-circuit of the magnetic fluxes of N pole and S pole. An electric angle of a cut portion shown in Fig. 22B is requested by a following formula[.]:

cut portion electric angle = 180 degrees − {2 x phase number to be excited / rotor pole number x electric motor phase number} degrees

This devotes the improvement of the output efficiency of the electric machine by making the minimum the conversion loss accompanied with the electric pole conversion generated in the coil.

Fig. 22C and Fig. 22D show the structures having the magnetic pole on the inner peripheral face and have the reversal structures shown in Fig. 22A and Fig. 22B. In Fig. 22E and Fig. 22F the magnetic poles are the right face and in Fig. 22G and Fig. 22H the magnetic poles are the left face. Figs. 24A and 24B are [Fig. 24 is a]

schematic views view showing four kinds of kind electromagnets of the six pole electric machine and the magnets of the inner and outer rotor. Figs. 24A includes Figs. 24A1-24A4, and Fig. 24B includes Figs. 24B5 and 24B6. Fig. 24A1 shows an outer periphery magnetic pole type electromagnet, Fig. 24A2 shows an outer periphery magnetic pole type electromagnet, Fig. 24A3 shows a right face magnetic pole type electromagnet and Fig. 24A4 shows a left face magnetic pole type electromagnet. Further, Fig. 24B5 24A5 shows an outer-rotor use magnet and Fig. 24B6 24A6 shows an inner-rotor use magnet.

Figs. 25A-25J are examples Fig. 25 is an example showing a combination of the inner-rotor use magnets and electromagnets, and Figs. 26A-26J are examples Fig. 26 is an example showing a combination of the outer-rotor use magnets and electromagnets. Herein, the examples example shown in Figs. 26A-26J Fig. 26 will be explained. Fig. 26A is an example in which the magnetic pole is formed with only one outer periphery magnetic pole type electromagnet. Fig. 26B is an example in which one electromagnet is arranged in an interior portion and one magnet is arranged in an outer side. Fig. 26C is an example having in which the magnet and the left face magnetic pole type electromagnet. Fig. 26D is an example in which two electromagnets are arranged, and Fig. 26I is an example in which three electromagnets are arranged. Fig. 26E and Fig. 26F are examples in which the magnet is combined to the outer face of the electromagnet shown in Fig. 26D and Fig. 26I. Fig. 26F, Fig. 26G and Fig. 26H are examples in which to one magnet or electromagnet two other magnets or electromagnets are combined.

Figs. 27A-27D Fig. 27 and Figs. 28A-28D Fig. 28 are examples in which the stator of the three phase electric machine uses using three pieces of the two pole

or the six pole inner and outer magnetic pole electromagnets. Fig. 27A and Fig. 27B show examples in which the electromagnets are applied to the stator of the alternating current two poles of the outer-rotor type rotor. Fig. 27A shows the stator and Fig. 27B shows a positional relationship of the electromagnets during a combination of the respective phase in which it shifts with electric angle ~~angel~~ of 120 degrees. Fig. 27C and Fig. 27D show examples in which the electromagnets are applied to the stator of the inner-rotor type rotor. Fig. 28 is an example in which the electromagnets are applied to the stator of the three phase six pole electric machine. Fig. 28A shows the stator and Fig. 28B shows a positional relationship of the electromagnets during a combination of the respective phase in which it shifts with electric angle ~~angel~~ of 120 degrees. Fig. 28C and Fig. 28D show examples in which the electromagnets are applied to the stator of the inner-rotor type rotor.

Figs. 29A-29J are ~~Fig. 29 is an~~ explanatory ~~view~~ views showing a structure of two pole electromagnet iron core and shows the structure in which it is possible ~~enable~~ to manufacture the iron core using only one manufacturing tool. Fig. 29A shows one winding use outer periphery magnetic pole of the iron core and Fig. 29B shows one winding use inner periphery magnetic pole of the iron core. An iron core 272 forms the outer periphery magnetic pole type and an iron core 273 forms the inner periphery magnetic pole type. Fig. 29E, Fig. 29F, and Fig. 29G show examples of two winding use outer periphery magnetic poles ~~pole~~ of the iron core and Fig. 29H, Fig. 29I, and Fig. 29J show examples of two winding use inner periphery magnetic poles ~~pole~~ of the

iron core. The structures shown in Fig. 29E, Fig. 29F, Fig. 29G, ~~and~~ Fig. 29H, Fig. 29I, and Fig. 29J ~~are validly to utilize~~ can be utilized as the three-phase electric machine.

Figs. 30A-30F are ~~Fig. 30 is an~~ explanatory views ~~view~~ showing an iron core structure to lessen the eddy current loss of the alternating current electromagnet. Fig. 30A and Fig. 30B show the iron core structures in which the sintering member and the iron powder are solidified by the bonding material. Fig. 30C and Fig. 30D show examples of a combination of an electromagnetic steel plate 281b with an iron core 281a in which the sintering material and the iron powder are bonded by the bonding material. Fig. 30E and Fig. 30F show examples of a combination of an electromagnetic steel plate 282b with an iron core 282a which constitutes a squeezing structure of a thick iron plate having slits 283.